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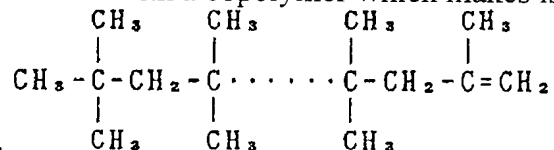
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## CLAIMS

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(57) [Claim(s)]

[Claim 1] It has one double bond at the end with a copolymer which makes isobutylene a



subject, and is a structural formula.

As opposed to basic composition thing 100 weight section which it came out of, and mixed 40 to 50% of KF, and 60 to 50% of  $\text{AlF}_3$ , and was made into 100% into polybutene expressed,  $\text{K}_2\text{SiF}_6$ ,  $\text{K}_2\text{TiF}_6$ ,  $\text{K}_2\text{ZrF}_6$ , What carried out dispersion mixing of 0.5 to 5.0 weight section, in addition the flux which changes for one sort of  $\text{K}_2\text{PbF}_6$ , or two sorts or more uniformly in total, A brazing method of an aluminum material which heats an aluminum material used as the above-mentioned pair in a non-oxidizing atmosphere and to which melting of the wax material which exists between aluminum materials used as a pair is carried out after applying to the surface of at least one aluminum material of the aluminum materials which serve as a pair and are brazed mutually.

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## DETAILED DESCRIPTION

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[Detailed Description of the Invention]

(Field of the Invention)

The brazing method of the aluminum material concerning this invention, It uses, when aluminum or aluminum alloys (these are named generically and it is considered as an aluminum material in this specification.) are brazed and it builds various products, and when building the heat exchanger made from an aluminum material used, for example as a radiator etc., it uses.

(PRIOR ART)

For example, when building the heat exchanger made from an aluminum material, where the heat exchanger tube made from an aluminum material and the same radiation fin made from an aluminum material are combined, these heat exchanger tubes and a fin are heated all over a heating furnace. And melting of the wax material (aluminum alloy which contains Si 5 to 16%.) made to intervene between the contact surfaces of a heat exchanger tube and a fin beforehand is carried out, and a heat exchanger tube and a fin are brazed by this wax material. The oxide film of the surface of the aluminum material which constitutes the heat exchanger tube and the fin is destroyed in the case of this brazing, and in order to carry out as [ perform / brazing with a heat exchanger tube and a fin / good ], applying flux to a brazing part is performed widely.

Generally as flux used for brazing of such aluminum materials, the flux which mixed the halogenide of an alkaline metal or alkaline-earth metals and the halogenide of aluminum, Zn, and Mg was used widely conventionally.

The residue after brazing as flux without corrosiveness over an aluminum material on the British patent No. 1055914 specifications. What mixed 45 to 47% ("% in this specification is "% of the weight" when [ all ] it expresses the mixing ratio except for the case where the below-mentioned rate of a clad or humidity is expressed.) of KF, and 55 to 53% of  $\text{AlF}_3$  is indicated.

(Object of the Invention)

However, inconvenience which is described below is produced in the brazing of the conventional aluminum material performed using the above flux.

That is, in the conventional brazing method, also when which flux was used, the flux which uses water as carrier fluid and is used for brazing was distributed with prescribed concentration in water, and it was considered as suspension.

Although this suspension is applied to a brazing portion before brazing, Even if what is necessary is to apply the contact portion of a heat exchanger tube and a fin, etc. only to a brazing part and flux originally applies them to the other portion, Flux is not only consumed vainly, but the residue processing after brazing becomes troublesome (when a flux residue has the corrosiveness over an aluminum material). It must stop having to wash a lot of corrosive residue. Even when there is no corrosiveness in residue, adhere on the surface of a fin and ventilation resistance is increased, and also when residue is remarkable and there is, this residue will block a fin. [ much ]

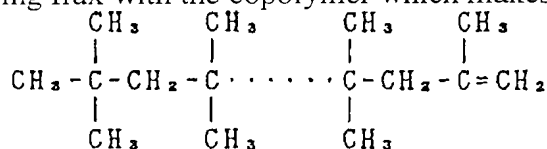
however, the case where water is used as carrier fluid -- the viscosity of the suspension of flux -- \*\*\*\* -- it will become small (mobility becoming very good), and it will become very difficult to apply this suspension only to a brazing part. Therefore, the suspension of flux was conventionally applied not only to a portion required for brazing but to the other portion with the spray etc. For this reason, it was not avoided that the above problems arise after brazing. When it is going to distribute flux with water in the case of the flux which mixed KF meltable to water which is especially indicated by said British patent specification, and  $\text{AlF}_3$  insoluble to water, only KF becomes suspension-like and the presentation of flux changes easily selectively. When it changes, it will become impossible and to obtain sufficient brazing nature with change of the melting point.

It inquires partly as using a synthetic resin instead of water as carrier fluid is also written in said British patent specification. However, in the actual condition, when a synthetic resin is used, and a synthetic resin carbonizes with heating at the time of brazing, a carbon residue remains after brazing and it is supposed also from the field of residue processing also from the field of brazing nature that it is not desirable.

The vacuum brazing method for brazing in the high vacuum of  $10^{-3}$  -  $10^{-5}$  Torr is known as a method of brazing aluminum materials, without using flux. However, in the case of this vacuum brazing method, Zn made to contain in an aluminum material for corrosion prevention will disperse at the time of heating for brazing. The sacrificial corrosion operation accompanying adding Zn will become weak, and it will become impossible as a result, to expect sufficient corrosion resistance for the aluminum material products obtained by brazing. The brazing method of the aluminum material of this invention cancels each above inconvenience by devising the ingredient of flux, and carrier fluid of this flux, and reduces the amount of the flux used and aims at reduction of the cost which soldering takes.

(The means for solving a technical problem)

In the brazing method of the aluminum material of this invention, it has one double bond at the end as carrier fluid for distributing flux with the copolymer which makes isobutylene a



subject, and is a structural formula.

It comes out and the polybutene expressed is used.

In brazing, what carried out dispersion mixing of the flux uniformly into such polybutene, After applying to the surface of at least one aluminum material of the aluminum materials which serve as a pair and are brazed mutually, the aluminum material used as the above-mentioned pair is heated in a non-oxidizing atmosphere, and melting of the wax material

which exists between the aluminum materials used as a pair is carried out.

Basic composition thing 100 weight section which mixed 40 to 50% of KF and 60 to 50% of  $\text{AlF}_3$ , and was made into 100% into the above-mentioned polybutene as flux which carries out dispersion mixing is received, 0.5 - 5.0 weight-section \*\*\*\*\* is used for one sort of  $\text{K}_2\text{SiF}_6$ ,  $\text{K}_2\text{TiF}_6$ ,  $\text{K}_2\text{ZrF}_6$ , and  $\text{K}_2\text{PbF}_6$ , or two sorts or more in total.

(Work for )

In the brazing method of the aluminum material of this invention, since the polybutene used as carrier fluid of flux has viscosity big enough compared with water even though it is liquid, it becomes possible to apply flux only to the brazing portion to need. As a result, while stopping the amount of the flux used few, the flux residue after brazing can be lessened.

Polybutene produces neither aggravation of brazing nature, nor clogging of a fin, without a carbon residue arising after brazing, in order to depolymerize and sublimate at about 300 \*\* below the brazing temperature (usually about 600 \*\*) of aluminum materials.

Basic composition thing 100 weight section which mixed 40 to 50% of KF and 60 to 50% of  $\text{AlF}_3$ , and was made into 100% as flux mixed into polybutene is received,  $\text{K}_2\text{SiF}_6$ ,  $\text{K}_2\text{TiF}_6$ ,  $\text{K}_2\text{ZrF}_6$ , In order to use 0.5 - 5.0 weight-section \*\*\*\*\* for one sort of  $\text{K}_2\text{PbF}_6$ , or two sorts or more in total, it not only can obtain brazing nature sufficient by little flux, but the flux residue after brazing becomes as [ have / corrosiveness over an aluminum material ]. It becomes unnecessary therefore, to wash this flux residue after brazing also in the case of the product which requires corrosion resistance.

Having made the mixing ratio of KF in the above-mentioned basic composition thing and  $\text{AlF}_3$  into the above-mentioned range is based on the following reason.

First, in less than 40%, the melting point of flux becomes high too much, and the content of KF is wax material (aluminum alloy containing many Si.). In detail, it is below-mentioned referring to the example. It becomes more than the melting point. On the contrary, if the content of KF exceeds 50%, KF unreacted after brazing will remain in a brazing part. When the melting point of flux becomes higher than the melting point of wax material, brazing nature gets worse, and when unreacted KF remains in a brazing part, these remains KF absorb moisture and it becomes a cause which a brazing part corrodes.

In the case of this invention, as flux mixed in the above-mentioned polybutene, 0.5 - 5.0 weight-section \*\*\*\*\* is used for one sort of  $\text{K}_2\text{SiF}_6$ ,  $\text{K}_2\text{TiF}_6$ ,  $\text{K}_2\text{ZrF}_6$ , and  $\text{K}_2\text{PbF}_6$ , or two sorts or more in total to the basic composition thing 100 above-mentioned weight section. For this reason, the brazing nature of aluminum materials becomes very good. therefore, the amount of the flux used and the residue of the flux [ it is few, end and ] after brazing -- \*\*\*\* - it becomes there is less [ little ]

The reason for having made into 0.5 to 5.0 weight section the rate which adds one sort of  $\text{K}_2\text{SiF}_6$  to basic composition thing 100 weight section,  $\text{K}_2\text{TiF}_6$ ,  $\text{K}_2\text{ZrF}_6$ , and  $\text{K}_2\text{PbF}_6$  or two sorts or more is as follows. First, in less than 0.5 weight section, the effect on the brazing disposition accompanying adding these is not expectable. On the contrary, when these are added exceeding 5.0%, black insoluble resid is produced after brazing and it becomes a cause in which a fin carries out clogging. For this reason, the above-mentioned rate was made into the range of 0.5 to 5.0 weight section.

In the case of this invention, the addition of the flux to the inside of polybutene has 2 to 9% of preferred range. This reason is as follows. First, when an addition is less than 2%, the absolute magnitude of flux is insufficient and brazing nature is reduced. On the contrary, when it adds exceeding 9%, the quantity of the residue produced after brazing increases with the amount-used increase of flux, and the appearance of a brazing portion is worsened, and in being still more remarkable, it blocks the brazed fin. By these, the range with the above-mentioned preferred addition was made into 2 to 9%. however -- the case where flux is added exceeding 9% -- about 50% -- until -- it does not become a problem in particular from the field of brazing nature.

(EXAMPLE)

Next, it explains about the experiment conducted in order to check the effect of this invention. First, polybutene explains about the first experiment conducted in order to know whether it has \*\*\*\* as carrier fluid of flux. It was made to go up gradually in this first experiment, as the curve a of Drawing 1 shows the temperature in this heating furnace, a molecular weight putting the polybutene of 1000 in a heating furnace, and measuring the weight of this polybutene. As a result, the weight of polybutene decreased, as the curve b showed to the figure, and it was sublimated about 100% at about 450 \*\*, and, behind, no residue remained. This thing showed that polybutene depolymerized at a temperature lower than 600 \*\* which is the brazing temperature of an aluminum material, and sublimated thoroughly. This thing means that the excessive residue based on existence of carrier fluid does not occur, if polybutene is used as carrier fluid.

Although a molecular weight can use the thing of 200-2500 as polybutene, viscosity changes with molecular weights (viscosity becomes high, so that there are many molecular weights.). For example, the molecular weight of the viscosity of the polybutene of 1000 is about 10000 cp. . Therefore, the polybutene which has suitable viscosity (that whose viscosity is about 8000 cp can use it preferably when manufacturing a heat exchanger.) according to the shape of a brazing portion, etc. is chosen. However, if it is in order to reduce viscosity, polybutene can also be diluted with an organic solvent (paraffin hydrocarbon).

Next, it explains about the second experiment conducted in order to curse when what mixed 40 to 50% of KF and 60 to 50% of  $\text{AlF}_3$ , and made into 100% is used as flux mixed in polybutene, and to check a sex. The brazing method of the aluminum material of this invention is preferred when the product made from an aluminum material carries out radiator manufacture. The 0.40-mm-thick clad plate generally used as aluminum material plate manufacturing material for this second experiment to constitute the heat exchanger tube of the heat exchanger used as a radiator etc. for this reason, Since a fin was constituted, it carried out as soldering with the 0.10-mm-thick aluminum material plate manufacturing material generally used.

The clad plate of these is what carried out the clad (it is a total of 20% in both sides) of the hide material which is wax material on the surface of a core material to both sides at the rate of a clad of 10% (thickness of the cladding layer (\*\*\*\*\*) to the thickness of the whole board comparatively), a core material -- JIS 3003 material (Si -- 0.6 -- % -- less than -- Fe -- in other impurities, each thing at 0.05% or less 0.10% or less 1.0 to 1.5% 0.05 to 0.20% 0.7% or less.) [ Cu ] [ Mu ] [ Zn ] In hide material, it is JIS 4343 material (Si 6.8 to 8.2%) about what the sum total of the impurity considered it as 0.15% or less, and set the remainder to aluminum.

Fe used 0.8% or less, Cu used 0.25% or less, in each thing, 0.10% or less considered it as 0.15% or less, in other impurities, the sum total of the impurity carried out [ Zn ] at 0.05% or less 0.20% or less, and Mn used, respectively what set the remainder to aluminum.

As an aluminum material for fins, it is JIS 7072 material (Si and Fe 0.7% or less in total). Cu used 0.10% or less, Mn used 0.10% or less, in each thing, 0.10% or less considered it as 0.15% or less, in other impurities, the sum total of the impurity carried out [ Zn ] at 0.05% or less 0.8 to 1.3%, and Mg used what set the remainder to aluminum.

As shown in Drawing 2, this clad plate 1 and the plate 2 for fins the lower end edge of the plate 2, It combined in the state where it dashed against the upper surface of the clad plate 1, and the result as shown in the place brazed mutually and the 1st table by the brazing method of this invention, the brazing method which uses water as carrier fluid like the former, and the vacuum brazing method which does not use flux was able to be obtained.

If the post was taken for conducting the second experiment,  $\text{N}_2$  gas atmosphere was used as a non-corrosive atmosphere, but the dew point at the time of brazing was changed in -15 \*\*--30 \*\*, and the influence which the concentration of  $\text{N}_2$  gas has on brazing nature also examined it collectively. When brazing, after preheating the clad plate 1 and the plate 2 which were

together put as shown in Drawing 2 for 3 minutes at 150 \*\*, at 600 \*\*, they were heated for 3 minutes and brazed.

the column which expresses post-processing in this 1st table -- " -- not having flushed the residue of flux after brazing with-less" -- " -- it means, respectively that owner" flushed the residue of flux after brazing.

Brazing nature in the column to express "it is dramatically good", The state where it is continuing without it being well-shaped for the fillet of the wax material formed between the upper surface of the clad plate 1 and the lower end edge of the plate 2 to cover the overall length of a brazing part, and breaking off after brazing "fitness", Although some of the shape of a fillet are bad, the overall length is continued and followed mostly and the fillet shows the state where the fillet of a "defect" is discontinuous and there is a problem also in brazing intensity about the state of a brazing part where there is no problem in brazing intensity, respectively.

The depth (unit mm) of the deepest thing of the pitting produced in the clad plate 1 showed the result of the examination which measured the corrosion resistance of the clad plate 1 and the plate 2 after brazing to the column of the corrosion test result. Pitting depth is judged that the corrosion resistance of a thing of 0.1 mm or less is good. After carrying out continuation of the corrosion test for 720 hours (for 30 days) by the copper accelerated acetic acid salt spray test method provided in JIS H 8681 and doing it, it was done by measuring the depth of pitting produced in the clad plate 1. A copper accelerated acetic acid salt spray test method is 50 \*\* atmosphere about the corrosive liquids which adjusted 5% of NaCl suspension to PH3 with acetic acid, and also added 100 ppm of  $\text{Cu}^{2+}$  ion in the form of the cupric chloride, It sprays at a rate of 1.0-2.0 ml/80cm<sup>2</sup>/hr, and a specimen is put to in a fog [ of these corrosive liquids ] throughout an examination.

Mix in the polybutene which is carrier fluid and the flux which mixed 40 to 50% of KF and 60 to 50% of  $\text{AlF}_3$ , and the passage clear from such 1st table showing the result of the second experiment made into 100% is applied on the surface of an aluminum material, when it brazes these aluminum materials, as long as the dew point is maintained at less than -20 \*\*, good brazing can be performed and, moreover, there is no problem in the corrosion resistance after brazing also as remaining as it is about the residue of flux -- \*\*\*\* -- it has checked.

Flux which what was shown in the 1st table as the comparative example 3 used (KCl; 40%) LiCl; 19%, NaCl; 25%,  $\text{ZnCl}_2$ ; 8%, LiF; since 8% of residue has the corrosiveness over an aluminum material, unless this residue is flushed after brazing, the corrosion of an aluminum material becomes remarkable.

In order to check the effect of this invention, as flux mixed in polybutene, As opposed to basic composition thing 100 weight section which mixed 40 to 50% of KF, and 60 to 50% of  $\text{AlF}_3$ , and was made into 100%, It explains about the third experiment conducted in order to check the effect at the time of using 0.5 - 5.0 weight-section \*\*\*\*\* for one sort of  $\text{K}_2\text{SiF}_6$ ,  $\text{K}_2\text{TiF}_6$ ,  $\text{K}_2\text{ZrF}_6$ , and  $\text{K}_2\text{PbF}_6$ , or two sorts or more in total. In this third experiment, the same clad plate 1 and plate 2 as a case of the second experiment which were mentioned above were used, and it brazed in the procedure as the case of an experiment of the above second in which it is the same in dew point-30 \*\*  $\text{N}_2$  gas atmosphere. By this third experiment, the result as shown in the 2nd table was able to be obtained.

About the example of this invention, the residue produced after brazing presupposed that it remains as it is entirely also about the comparative example, and did not carry out washing away.

Although the fillet of "\*\*\*" is discontinuous in a part of brazing part, the state where "O" is continuing in the column showing brazing nature without the fillet of the wax material formed between the lower end edge of the clad plate 1 and the upper surface of the plate 2 continuing and breaking off for the overall length of a brazing part after brazing, The state where a fillet is hardly formed in the state where temporary brazing intensity is obtained as for "x" is

shown, respectively.

"O" in a corrosion-resistant column shows the state where the discoloration (white of an aluminum oxide) accompanying corrosion was not able to be observed at all on the surface of the clad plate 1, in after a corrosion test. From the corrosive field, it was altogether satisfactory, including a comparative example by experiment.

The corrosive examination which can be set in this case was done by putting the clad plate 1 and the plate 2 into a thermostat, and neglecting it under the conditions of the temperature of 40 \*\*, and 90% of relative humidity after brazing, for 150 hours.

When aluminum materials were brazed by the brazing method of this invention as for a passage clear from such 2nd table showing the result of the third experiment, even if it lessened quantity of the flux to be used fairly, good brazing could be performed and it has checked that there was no problem also in the corrosion resistance after brazing.

As a result of being able to lessen quantity of the flux used at the time of brazing, quantity of the residue of the flux after brazing can also be lessened and this residue worsening appearance of a heat exchanger table, or blocking a fin is lost.

#### (EFFECT OF THE INVENTION)

Since it constitutes and carries out as the brazing method of the aluminum material of this invention was described above, It becomes possible to apply flux only to a required portion, and it not only can aim at manufacturing cost reduction of the brazing products accompanying the amount-used reduction of flux, but can prevent the quality of the brazing products by the residue of excessive flux, and performance degradation. Even if it lessens the amount of the flux used, the brazing intensity of aluminum materials can fully be secured and, moreover, sufficient corrosion resistance can be secured. As a result, it has the outstanding endurance and, moreover, cheap aluminum material brazing products can be obtained.

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## TECHNICAL FIELD

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### (Field of the Invention)

A brazing method of an aluminum material concerning this invention, It uses, when aluminum or aluminum alloys (these are named generically and it is considered as an aluminum material in this specification.) are brazed and it builds various products, and when building a heat exchanger made from an aluminum material used, for example as a radiator etc., it uses.

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## PRIOR ART

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### (PRIOR ART)

For example, when building a heat exchanger made from an aluminum material, where a heat exchanger tube made from an aluminum material and same radiation fin made from an aluminum material are combined, these heat exchanger tubes and a fin are heated all over a heating furnace. And melting of the wax material (aluminum alloy which contains Si 5 to 16%.) made to intervene between contact surfaces of a heat exchanger tube and a fin beforehand is carried out, and a heat exchanger tube and a fin are brazed by this wax material. An oxide film of the surface of an aluminum material which constitutes a heat exchanger tube and a fin is destroyed in the case of this brazing, and in order to carry out as [ perform / brazing with a heat exchanger tube and a fin / good ], applying flux to a brazing part is performed widely.

Generally as flux used for brazing of such aluminum materials, flux which mixed a

halogenide of an alkaline metal or alkaline-earth metals and a halogenide of aluminum, Zn, and Mg was used widely conventionally.

Residue after brazing as flux without corrosiveness over an aluminum material on the British patent No. 1055914 specifications. What mixed 45 to 47% ("% in this specification is "% of the weight" when [ all ] it expresses the mixing ratio except for a case where the below-mentioned rate of a clad or humidity is expressed.) of KF, and 55 to 53% of  $\text{AlF}_3$  is indicated.

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## EFFECT OF THE INVENTION

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## TECHNICAL PROBLEM

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### (Object of the Invention)

However, inconvenience which is described below is produced in brazing of the conventional aluminum material performed using the above flux.

That is, in a conventional brazing method, also when which flux was used, flux which uses water as carrier fluid and is used for brazing was distributed with prescribed concentration in water, and it was considered as suspension.

Although this suspension is applied to a brazing portion before brazing, Even if what is necessary is to apply a contact portion of a heat exchanger tube and a fin, etc. only to a brazing part and flux originally applies them to the other portion, Flux is not only consumed vainly, but residue processing after brazing becomes troublesome (when a flux residue has the corrosiveness over an aluminum material). It must stop having to wash a lot of corrosive residue. Even when there is no corrosiveness in residue, adhere on the surface of a fin and ventilation resistance is increased, and also when residue is remarkable and there is, this residue will block a fin. [ much ]

however, the case where water is used as carrier fluid -- the viscosity of the suspension of flux -- \*\*\*\* -- it will become small (mobility becoming very good), and it will become very difficult to apply this suspension only to a brazing part. Therefore, the suspension of flux was conventionally applied not only to a portion required for brazing but to the other portion with the spray etc. For this reason, it was not avoided that the above problems arise after brazing. When it is going to distribute flux with water in the case of the flux which mixed KF meltable to water which is especially indicated by said British patent specification, and  $\text{AlF}_3$  insoluble to water, only KF becomes suspension-like and the presentation of flux changes easily selectively. When it changes, it will become impossible and to obtain sufficient brazing nature with change of the melting point.

It inquires partly as using a synthetic resin instead of water as carrier fluid is also written in said British patent specification. However, in the actual condition, when a synthetic resin is used, and a synthetic resin carbonizes with heating at the time of brazing, a carbon residue



remains after brazing and it is supposed also from the field of residue processing also from the field of brazing nature that it is not desirable.

The vacuum brazing method for brazing in a high vacuum of  $10^{-3}$  -  $10^{-5}$  Torr is known as a method of brazing aluminum materials, without using flux. However, in the case of this vacuum brazing method, Zn made to contain in an aluminum material for corrosion prevention will disperse at the time of heating for brazing. A sacrificial corrosion operation accompanying adding Zn will become weak, and it will become impossible as a result, to expect sufficient corrosion resistance for aluminum material products obtained by brazing. A brazing method of an aluminum material of this invention cancels each above inconvenience by devising an ingredient of flux, and carrier fluid of this flux, and reduces the amount of flux used and aims at reduction of cost which soldering takes.

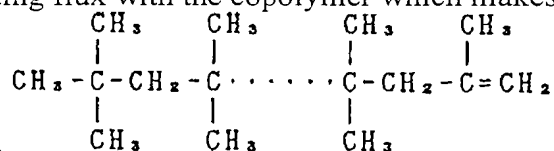
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## MEANS

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(The means for solving a technical problem)

In the brazing method of the aluminum material of this invention, it has one double bond at the end as carrier fluid for distributing flux with the copolymer which makes isobutylene a



subject, and is a structural formula.

It comes out and the polybutene expressed is used.

In brazing, what carried out dispersion mixing of the flux uniformly into such polybutene, After applying to the surface of at least one aluminum material of the aluminum materials which serve as a pair and are brazed mutually, the aluminum material used as the above-mentioned pair is heated in a non-oxidizing atmosphere, and melting of the wax material which exists between the aluminum materials used as a pair is carried out.

Basic composition thing 100 weight section which mixed 40 to 50% of KF and 60 to 50% of  $\text{AlF}_3$ , and was made into 100% into the above-mentioned polybutene as flux which carries out dispersion mixing is received, 0.5 - 5.0 weight-section \*\*\*\*\* is used for one sort of  $\text{K}_2\text{SiF}_6$ ,  $\text{K}_2\text{TiF}_6$ ,  $\text{K}_2\text{ZrF}_6$ , and  $\text{K}_2\text{PbF}_6$ , or two sorts or more in total.

(Work for )

In a brazing method of an aluminum material of this invention, since polybutene used as carrier fluid of flux has viscosity big enough compared with water even though it is liquid, it becomes possible to apply flux only to a brazing portion to need. As a result, while stopping the amount of flux used few, a flux residue after brazing can be lessened.

Polybutene produces neither aggravation of brazing nature, nor clogging of a fin, without a carbon residue arising after brazing, in order to depolymerize and sublimate at about 300 \*\* below brazing temperature (usually about 600 \*\*) of aluminum materials.

Basic composition thing 100 weight section which mixed 40 to 50% of KF and 60 to 50% of  $\text{AlF}_3$ , and was made into 100% as flux mixed into polybutene is received,  $\text{K}_2\text{SiF}_6$ ,  $\text{K}_2\text{TiF}_6$ ,  $\text{K}_2\text{ZrF}_6$ , In order to use 0.5 - 5.0 weight-section \*\*\*\*\* for one sort of  $\text{K}_2\text{PbF}_6$ , or two sorts or more in total, it not only can obtain brazing nature sufficient by little flux, but a flux residue after brazing becomes as [ have / corrosiveness over an aluminum material ]. It becomes unnecessary therefore, to wash this flux residue after brazing also in the case of a product which requires corrosion resistance.

Having made the mixing ratio of KF in the above-mentioned basic composition thing and  $\text{AlF}_3$  into the above-mentioned range is based on the following reason.

First, in less than 40%, the melting point of flux becomes high too much, and the content of KF is wax material (aluminum alloy containing many Si.). In detail, it is below-mentioned referring to the example. It becomes more than the melting point. On the contrary, if the content of KF exceeds 50%, KF unreacted after brazing will remain in a brazing part. When the melting point of flux becomes higher than the melting point of wax material, brazing nature gets worse, and when unreacted KF remains in a brazing part, these remains KF absorb moisture and it becomes a cause which a brazing part corrodes.

In the case of this invention, as flux mixed in the above-mentioned polybutene, 0.5 - 5.0 weight-section \*\*\*\*\* is used for one sort of  $K_2SiF_6$ ,  $K_2TiF_6$ ,  $K_2ZrF_6$ , and  $K_2PbF_6$ , or two sorts or more in total to the basic composition thing 100 above-mentioned weight section. For this reason, the brazing nature of aluminum materials becomes very good. therefore, the amount of the flux used and the residue of the flux [ it is few, end and ] after brazing -- \*\*\*\* - it becomes there is less [ little ]

The reason for having made into 0.5 to 5.0 weight section the rate which adds one sort of  $K_2SiF_6$  to basic composition thing 100 weight section,  $K_2TiF_6$ ,  $K_2ZrF_6$ , and  $K_2PbF_6$  or two sorts or more is as follows. First, in less than 0.5 weight section, the effect on the brazing disposition accompanying adding these is not expectable. On the contrary, when these are added exceeding 5.0%, black insoluble resid is produced after brazing and it becomes a cause in which a fin carries out clogging. For this reason, the above-mentioned rate was made into the range of 0.5 to 5.0 weight section.

In the case of this invention, the addition of the flux to the inside of polybutene has 2 to 9% of preferred range. This reason is as follows. First, when an addition is less than 2%, the absolute magnitude of flux is insufficient and brazing nature is reduced. On the contrary, when it adds exceeding 9%, the quantity of the residue produced after brazing increases with the amount-used increase of flux, and the appearance of a brazing portion is worsened, and in being still more remarkable, it blocks the brazed fin. By these, the range with the above-mentioned preferred addition was made into 2 to 9%. however -- the case where flux is added exceeding 9% -- about 50% -- until -- it does not become a problem in particular from the field of brazing nature.

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## EXAMPLE

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### (EXAMPLE)

Next, it explains about the experiment conducted in order to check the effect of this invention. First, polybutene explains about the first experiment conducted in order to know whether it has \*\*\*\* as carrier fluid of flux. It was made to go up gradually in this first experiment, as the curve a of Drawing 1 shows the temperature in this heating furnace, a molecular weight putting the polybutene of 1000 in a heating furnace, and measuring the weight of this polybutene. As a result, the weight of polybutene decreased, as the curve b showed to the figure, and it was sublimated about 100% at about 450 \*\*, and, behind, no residue remained. This thing showed that polybutene depolymerized at a temperature lower than 600 \*\* which is the brazing temperature of an aluminum material, and sublimated thoroughly. This thing means that the excessive residue based on existence of carrier fluid does not occur, if polybutene is used as carrier fluid.

Although a molecular weight can use the thing of 200-2500 as polybutene, viscosity changes with molecular weights (viscosity becomes high, so that there are many molecular weights.). For example, the molecular weight of the viscosity of the polybutene of 1000 is about 10000 cp. . Therefore, the polybutene which has suitable viscosity (that whose viscosity is about 8000 cp can use it preferably when manufacturing a heat exchanger.) according to the shape

of a brazing portion, etc. is chosen. However, if it is in order to reduce viscosity, polybutene can also be diluted with an organic solvent (paraffin hydrocarbon).

Next, it explains about the second experiment conducted in order to check when what mixed 40 to 50% of KF and 60 to 50% of  $\text{AlF}_3$ , and made into 100% is used as flux mixed in polybutene, and to check a sex. The brazing method of the aluminum material of this invention is preferred when the product made from an aluminum material carries out radiator manufacture. The 0.40-mm-thick clad plate generally used as aluminum material plate manufacturing material for this second experiment to constitute the heat exchanger tube of the heat exchanger used as a radiator etc. for this reason, Since a fin was constituted, it carried out as soldering with the 0.10-mm-thick aluminum material plate manufacturing material generally used.

The clad plate of these is what carried out the clad (it is a total of 20% in both sides) of the hide material which is wax material on the surface of a core material to both sides at the rate of a clad of 10% (thickness of the cladding layer (\*\*\*\*\*) to the thickness of the whole board comparatively), a core material -- JIS 3003 material (Si -- 0.6 -- % -- less than -- Fe -- in other impurities, each thing at 0.05% or less 0.10% or less 1.0 to 1.5% 0.05 to 0.20% 0.7% or less.) [ Cu ] [ Mn ] [ Zn ] In hide material, it is JIS 4343 material (Si 6.8 to 8.2%) about what the sum total of the impurity considered it as 0.15% or less, and set the remainder to aluminum. Fe used 0.8% or less, Cu used 0.25% or less, in each thing, 0.10% or less considered it as 0.15% or less, in other impurities, the sum total of the impurity carried out [ Zn ] at 0.05% or less 0.20% or less, and Mn used, respectively what set the remainder to aluminum.

As an aluminum material for fins, it is JIS 7072 material (Si and Fe 0.7% or less in total). Cu used 0.10% or less, Mn used 0.10% or less, in each thing, 0.10% or less considered it as 0.15% or less, in other impurities, the sum total of the impurity carried out [ Zn ] at 0.05% or less 0.8 to 1.3%, and Mg used what set the remainder to aluminum.

As shown in Drawing 2, this clad plate 1 and the plate 2 for fins the lower end edge of the plate 2, It combined in the state where it dashed against the upper surface of the clad plate 1, and the result as shown in the place brazed mutually and the 1st table by the brazing method of this invention, the brazing method which uses water as carrier fluid like the former, and the vacuum brazing method which does not use flux was able to be obtained.

If the post was taken for conducting the second experiment,  $\text{N}_2$  gas atmosphere was used as a non-corrosive atmosphere, but the dew point at the time of brazing was changed in -15 \*\*--30 \*\*, and the influence which the concentration of  $\text{N}_2$  gas has on brazing nature also examined it collectively. When brazing, after preheating the clad plate 1 and the plate 2 which were together put as shown in Drawing 2 for 3 minutes at 150 \*\*, at 600 \*\*, they were heated for 3 minutes and brazed.

the column which expresses post-processing in this 1st table -- " -- not having flushed the residue of flux after brazing with-less" -- " -- it means, respectively that owner" flushed the residue of flux after brazing.

Brazing nature in the column to express "it is dramatically good", The state where it is continuing without it being well-shaped for the fillet of the wax material formed between the upper surface of the clad plate 1 and the lower end edge of the plate 2 to cover the overall length of a brazing part, and breaking off after brazing "fitness", Although some of the shape of a fillet are bad, the overall length is continued and followed mostly and the fillet shows the state where the fillet of a "defect" is discontinuous and there is a problem also in brazing intensity about the state of a brazing part where there is no problem in brazing intensity, respectively.

The depth (unit mm) of the deepest thing of the pitting produced in the clad plate 1 showed the result of the examination which measured the corrosion resistance of the clad plate 1 and the plate 2 after brazing to the column of the corrosion test result. Pitting depth is judged that the corrosion resistance of a thing of 0.1 mm or less is good. After carrying out continuation

of the corrosion test for 720 hours (for 30 days) by the copper accelerated acetic acid salt spray test method provided in JIS H 8681 and doing it, it was done by measuring the depth of pitting produced in the clad plate 1. A copper accelerated acetic acid salt spray test method is 50 \*\* atmosphere about the corrosive liquids which adjusted 5% of NaCl suspension to PH3 with acetic acid, and also added 100 ppm of  $\text{Cu}^{2+}$  ion in the form of the cupric chloride, It sprays at a rate of 1.0-2.0 ml/80cm<sup>2</sup>/hr, and a specimen is put to in a fog [ of these corrosive liquids ] throughout an examination.

Mix in the polybutene which is carrier fluid and the flux which mixed 40 to 50% of KF and 60 to 50% of  $\text{AlF}_3$ , and the passage clear from such 1st table showing the result of the second experiment made into 100% is applied on the surface of an aluminum material, when it brazes these aluminum materials, as long as the dew point is maintained at less than -20 \*\*, good brazing can be performed and, moreover, there is no problem in the corrosion resistance after brazing also as remaining as it is about the residue of flux -- \*\*\*\* -- it has checked.

Flux which what was shown in the 1st table as the comparative example 3 used (KCl; 40%) LiCl; 19%, NaCl; 25%,  $\text{ZnCl}_2$ ; 8%, LiF; since 8% of residue has the corrosiveness over an aluminum material, unless this residue is flushed after brazing, the corrosion of an aluminum material becomes remarkable.

In order to check the effect of this invention, as flux mixed in polybutene, As opposed to basic composition thing 100 weight section which mixed 40 to 50% of KF, and 60 to 50% of  $\text{AlF}_3$ , and was made into 100%, It explains about the third experiment conducted in order to check the effect at the time of using 0.5 - 5.0 weight-section \*\*\*\*\* for one sort of  $\text{K}_2\text{SiF}_6$ ,  $\text{K}_2\text{TiF}_6$ ,  $\text{K}_2\text{ZrF}_6$ , and  $\text{K}_2\text{PbF}_6$ , or two sorts or more in total. In this third experiment, the same clad plate 1 and plate 2 as a case of the second experiment which were mentioned above were used, and it brazed in the procedure as the case of an experiment of the above second in which it is the same in dew point-30 \*\*  $\text{N}_2$  gas atmosphere. By this third experiment, the result as shown in the 2nd table was able to be obtained.

About the example of this invention, the residue produced after brazing presupposed that it remains as it is entirely also about the comparative example, and did not carry out washing away.

Although the fillet of "\*\*\*" is discontinuous in a part of brazing part, the state where "O" is continuing in the column showing brazing nature without the fillet of the wax material formed between the lower end edge of the clad plate 1 and the upper surface of the plate 2 continuing and breaking off for the overall length of a brazing part after brazing, The state where a fillet is hardly formed in the state where temporary brazing intensity is obtained as for "x" is shown, respectively.

"O" in a corrosion-resistant column shows the state where the discoloration (white of an aluminum oxide) accompanying corrosion was not able to be observed at all on the surface of the clad plate 1, in after a corrosion test. From the corrosive field, it was altogether satisfactory, including a comparative example by experiment.

The corrosive examination which can be set in this case was done by putting the clad plate 1 and the plate 2 into a thermostat, and neglecting it under the conditions of the temperature of 40 \*\*, and 90% of relative humidity after brazing, for 150 hours.

When aluminum materials were brazed by the brazing method of this invention as for a passage clear from such 2nd table showing the result of the third experiment, even if it lessened quantity of the flux to be used fairly, good brazing could be performed and it has checked that there was no problem also in the corrosion resistance after brazing.

As a result of being able to lessen quantity of the flux used at the time of brazing, quantity of the residue of the flux after brazing can also be lessened and this residue worsening appearance of a heat exchanger table, or blocking a fin is lost.

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

The diagram showing the state of the weight loss of the polybutene accompanying a rise in heat in Drawing 1 and Drawing 2 are perspective views showing the combination state of the aluminum plate material of two sheets brazed mutually.

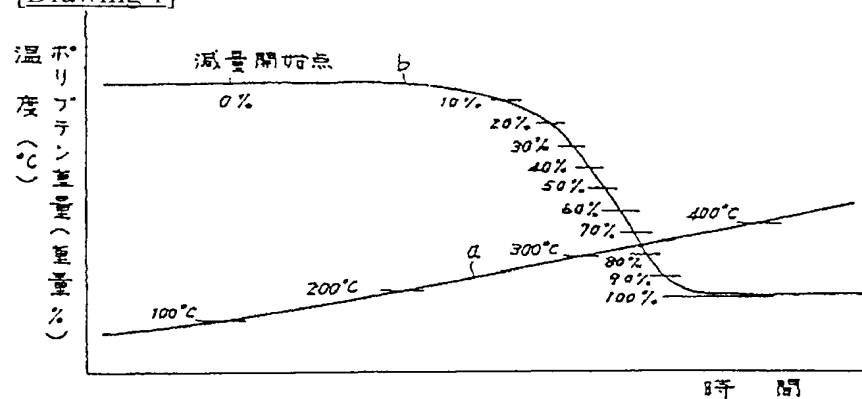
1: A clad plate, 2: plate.

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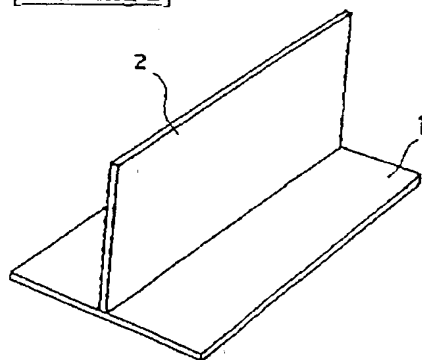
## DRAWINGS

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[Drawing 1]



[Drawing 2]



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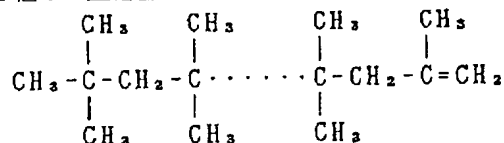
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(54)【発明の名称】 アルミニウム材のろう付方法

1

(57)【特許請求の範囲】

【請求項1】 イソブチレンを主体とする共重合体で末端に1個の二重結合を有し、構造式



で表わされるポリブテン中に、40～50%のKFと60～50%の $\text{AlF}_3$ とを混合して100%とした基本組成物100重量部に対して、 $\text{K}_2\text{SiF}_6$ 、 $\text{K}_2\text{TiF}_6$ 、 $\text{K}_2\text{ZrF}_6$ 、 $\text{K}_2\text{PbF}_6$ の1種又は2種以上を合計で0.5～5.0重量部加えて成るフラックスを均一に分散混合したものを、対となって互いにろう付されるアルミニウム材の内の、少なくとも一方のアルミニウム材の表面に塗布した後、上記対となるアルミニウム

2

材を非酸化性雰囲気中で加熱し、対となるアルミニウム材の間に存在するろう材を熔融させる、アルミニウム材のろう付方法。

【発明の詳細な説明】

(産業上の利用分野)

この発明に係るアルミニウム材のろう付方法は、アルミニウム、或はアルミニウム合金(本明細書では、これらを総称してアルミニウム材とする。)同士をろう付して、各種製品を造る場合に利用するもので、例えばラジエータ等として使用されるアルミニウム材製の熱交換器を造る場合に利用する。

(従来の技術)

例えばアルミニウム材製の熱交換器を造る場合、アルミニウム材製の伝熱管と、同じくアルミニウム材製の放熱フィンとを組み合わせた状態で、これら伝熱管とフィ

ンとを加熱炉中で加熱する。そして、予め伝熱管とフィンとの当接面間に介在させたりろ材（Siを5～16%含むアルミニウム合金。）を溶融させ、このろ材によって伝熱管とフィンとをろう付する。

このろう付作業の際、伝熱管やフィンを構成しているアルミニウム材の表面の酸化膜を破壊して、伝熱管とフィンとのろう付が良好に行なわれる様にする為、ろう付部にフラックスを塗布する事が、広く行なわれている。

この様なアルミニウム材同士のろう付に使用するフラックスとしては従来は一般的に、アルカリ金属やアルカリ土類金属のハロゲン化物と、Al、Zn、Mgのハロゲン化物とを混合したフラックスを広く使用していた。

更に、ろう付後の残渣がアルミニウム材に対する腐食性を持たないフラックスとして、英国特許第1055914号明細書には、45～47%（本明細書に於ける「%」は、後述のクラッド率、或は湿度を表わす場合を除き、混合割合を表わす場合は総て「重量%」である。）のKFと55～53%の $AlF_3$ とを混合したものが開示されている。

（発明が解決しようとする課題）

ところが、上述の様なフラックスを使用して行なう、従来のアルミニウム材のろう付に於いては、次に述べる様な不都合を生じる。

即ち、従来のろう付方法に於いては、何れのフラックスを使用する場合に於いても、水を分散媒として使用し、ろう付に使用するフラックスを水の中に所定濃度で分散し、懸濁液としていた。

この懸濁液は、ろう付前にろう付部分に塗布するが、フラックスは本来、伝熱管とフィンとの接触部等、ろう付部のみ塗布すれば良く、それ以外の部分に塗布しても、フラックスが無駄に消費されるだけでなく、ろう付後の残渣処理が面倒になったり（フラックス残渣がアルミニウム材に対する腐食性を有する場合、多量の腐食性残渣を洗浄しなければならなくなる。）、残渣に腐食性がない場合でも、フィンの表面に付着して通気抵抗を増大したり、更に残渣が著しく多い場合には、この残渣がフィンを詰らせたりしてしまう。

ところが、水を分散媒として使用した場合、フラックスの懸濁液の粘度は極く小さいものとなって（流動性が極めて良くなって）、この懸濁液をろう付部にのみ塗布する事が極めて困難となる。従って従来は、ろう付に必要な部分だけでなく、それ以外の部分にもフラックスの懸濁液を、スプレー等によって塗布していた。この為、ろう付後に上述の様な問題が生じる事が避けられなかった。

特に、前記英国特許明細書に開示されている様な、水に可溶なKFと水に不溶な $AlF_3$ とを混合したフラックスの場合、フラックスを水で分散させようとした場合に、KFのみが懸濁液状となって、フラックスの組成が部分的に変化し易い。そして、変化した場合には、融点の変化に伴って十分なろう付性を得られなくなってしまう。

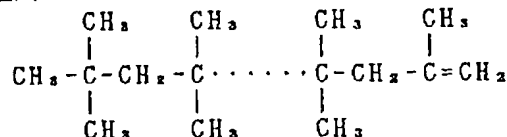
分散媒として水の代りに合成樹脂を使用する事も、前記英国特許明細書に記載されている様に、一部で研究されている。ところが、現状に於いては、合成樹脂を使用した場合、ろう付時の加熱に伴って合成樹脂が炭化する事により、ろう付後にカーボン残渣が残留し、ろう付性の面からも、残渣処理の面からも好ましくないとされている。

フラックスを使用する事なく、アルミニウム材同士をろう付する方法として、 $10^{-3} \sim 10^{-5}$  Torrの高真空中でろう付を行なう、真空ろう付法が知られている。しかしながら、この真空ろう付法の場合、防食の為にアルミニウム材中に含有させたZnが、ろう付の為の加熱時に飛散してしまう。その結果、Znを添加する事に伴う犠牲腐食作用が弱くなって、ろう付により得られるアルミニウム材製品に十分な耐食性を期待できなくなってしまう。

本発明のアルミニウム材のろう付方法は、フラックスの成分及びこのフラックスの分散媒を工夫する事により、上述の様な不都合を何れも解消すると共に、フラックスの使用量を低減して、ろう付けに要するコストの削減を図るものである。

（課題を解決するための手段）

本発明のアルミニウム材のろう付方法に於いては、フラックスを分散させる為の分散媒として、イソブチレンを主体とする共重合体で末端に1個の二重結合を有し、構造式



で表わされるポリブテンを使用する。

ろう付を行なう場合には、この様なポリブテン中に、フラックスを均一に分散混合したものを、対となって互いにろう付されるアルミニウム材の内の、少なくとも一方のアルミニウム材の表面に塗布した後、上記対となるアルミニウム材を非酸化性雰囲気中で加熱し、対となるアルミニウム材の間に存在するろ材を溶融させる。

更に、上記ポリブテン中に分散混合するフラックスとして、40～50%のKFと60～50%の $AlF_3$ とを混合して100%とした基本組成物100重量部に対して、 $K_2SiF_6$ 、 $K_2TiF_6$ 、 $K_2ZrF_6$ 、 $K_2PbF_6$ の1種又は2種以上を合計で0.5～5.0重量部加えたものを使用する。

（作 用）

本発明のアルミニウム材のろう付方法に於いて、フラックスの分散媒として使用されるポリブテンは、流動性はあるにしても、水に比べて十分に大きな粘性を有する為、必要とするろう付部分にのみフラックスを塗布する事が可能となる。この結果、フラックスの使用量を少なく抑えると同時に、ろう付後に於けるフラックス残渣を少なくする事ができる。

又、ポリブテンは、アルミニウム材同士のろう付温度（通常600℃程度）以下の、約300℃で解重合して昇華する為、ろう付後にカーボン残渣が生じる事もなく、ろう付性の悪化やフィンの目詰り等を生じる事もない。

又、ポリブテン中に混入するフラックスとして、40～50%のKFと60～50%の $\text{AlF}_3$ とを混合して100%とした基本組成物100重量部に対し、 $\text{K}_2\text{SiF}_6$ 、 $\text{K}_2\text{TiF}_6$ 、 $\text{K}_2\text{ZrF}_6$ 、 $\text{K}_2\text{PbF}_6$ の1種又は2種以上を、合計で0.5～5.0重量部加えたものを使用する為、少ないフラックスで十分なるろう付性を得られるだけでなく、ろう付後のフラックス残渣が、アルミニウム材に対する腐食性を有しない様になる。従って、耐食性を要する製品の場合にも、ろう付後にこのフラックス残渣を洗浄する必要がなくなる。

尚、上記基本組成物中のKFと $\text{AlF}_3$ との混合割合を上述の範囲としたのは、次の理由による。

先ず、KFの含有量が40%未満では、フラックスの融点が高くなり過ぎて、ろう材（Siを多く含むアルミニウム合金。詳しくは、後述の実施例参照。）の融点以上となる。反対に、KFの含有量が50%を越えると、ろう付後に未反応のKFがろう付部に残留する。フラックスの融点がろう材の融点よりも高くなった場合はろう付性が悪化し、未反応のKFがろう付部に残留した場合は、この残留KFが吸湿して、ろう付部が腐食する原因となる。

更に、本発明の場合には、上記ポリブテン中に混合するフラックスとして、上記基本組成物100重量部に対して、 $\text{K}_2\text{SiF}_6$ 、 $\text{K}_2\text{TiF}_6$ 、 $\text{K}_2\text{ZrF}_6$ 、 $\text{K}_2\text{PbF}_6$ の1種又は2種以上を、合計で0.5～5.0重量部加えたものを使用する。この為、アルミニウム材同士のろう付性が極めて良くなる。従って、フラックスの使用量も少なく済み、ろう付後に於けるフラックスの残渣も極く少なくなる。

尚、基本組成物100重量部に対する、 $\text{K}_2\text{SiF}_6$ 、 $\text{K}_2\text{TiF}_6$ 、 $\text{K}_2\text{ZrF}_6$ 、 $\text{K}_2\text{PbF}_6$ の1種又は2種以上を添加する割合を0.5～5.0重量部とした理由は、次の通りである。先ず、0.5重量部未満では、これらを加える事に伴うろう付性向上の効果を期待できない。反対に、5.0%を越えてこれらを加えた場合、ろう付後に、黒色の不溶性残渣を生じ、フィンが目詰りしたりする原因となる。この為、上記割合を0.5～5.0重量部の範囲とした。

又、本発明の場合、ポリブテン中へのフラックスの添加量は、2～9%の範囲が好ましい。この理由は次の通りである。先ず、添加量が2%未満の場合には、フラックスの絶対量が不足して、ろう付性を低下させる。反対に、9%を越えて添加した場合、フラックスの使用量増大に伴って、ろう付後に生じる残渣の量が多くなり、ろう付部分の外観を悪化させ、更に著しい場合には、ろう付されたフィンを目詰まりさせる。これらにより、上記添加量の好ましい範囲を2～9%とした。但し、9%を越えてフラックスを添加した場合でも、50%程度迄は、ろう付性の面からは特に問題とはならない。

（実施例）

次に、本発明の効果を確認する為に行なった実験に就いて説明する。

先ず、ポリブテンが、フラックスの分散媒としての適正を有するか否かを知る為に行なった、第一の実験に就いて説明する。この第一の実験では、分子量が1000のポリブテンを加熱炉中に入れ、このポリブテンの重量を測定しつつ、この加熱炉内の温度を第1図の曲線aで示す様に徐々に上昇させた。この結果、ポリブテンの重量は、同図に曲線bで示す様に減少し、450℃程度ではほぼ100%昇華して、後には何の残渣も残らなかった。

この事から、ポリブテンが、アルミニウム材のろう付温度である600℃よりも低い温度で解重合し、完全に昇華する事が解った。この事は、ポリブテンを分散媒として使用すれば、分散媒の存在に基づく余計な残渣が発生しない事を意味する。

尚、ポリブテンとしては、分子量が200～2500のものを使用できるが、分子量によって粘度が異なる（分子量が多い程、粘度は高くなる。例えば、分子量が1000のポリブテンの粘度は、約10000cpである。）。従って、ろう付部分の形状等に応じて適当な粘度（熱交換器を製造する場合、粘度が8000cp程度のものが、好ましく使用できる。）を有するポリブテンを選択する。但し、粘度を低下させる為ならば、ポリブテンを有機溶剤（パラフィン系炭化水素）によって希釈する事もできる。

次に、ポリブテン中に混合するフラックスとして、40～50%のKFと60～50%の $\text{AlF}_3$ とを混合して100%としたものを使用した場合のろう付け性を確認する為に行なった、第二の実験に就いて説明する。尚、本発明のアルミニウム材のろう付方法は、アルミニウム材製のラジエータ製造する場合に好適である。この為、この第二の実験は、ラジエータ等として使用される熱交換器の伝熱管を構成する為のアルミニウム材製板材として一般的に使用される、厚さが0.40mmのクラッド板と、フィンを構成する為に一般的に使用される、厚さ0.10mmのアルミニウム材製板材とのろう付けとして行なった。

このうちのクラッド板は、芯材の表面にろう材である皮材を、10%のクラッド率（板全体の厚さに対するクラッド層（皮材層）の厚さの割合）で両面にクラッド（両面で合計20%）したもので、芯材にはJIS 3003材（Siが0.6%以下、Feが0.7%以下、Cuが0.05～0.20%、Mnが1.0～1.5%、Znが0.10%以下、その他の不純物が、個々の物が0.05%以下で、不純物の合計が0.15%以下とし、残りをAlとしたもの）を、皮材にはJIS 4343材（Siが6.8～8.2%、Feが0.8%以下、Cuが0.25%以下、Mnが0.10%以下、Znが0.20%以下、その他の不純物が、個々の物が0.05%以下で、不純物の合計が0.15%以下とし、残りをAlとしたもの）を、それぞれ使用した。

又、フィン用のアルミニウム材としては、JIS 7072材（SiとFeとが合計で0.7%以下、Cuが0.10%以下、Mnが0.10%以下、Mgが0.10%以下、Znが0.8～1.3%、その他



の不純物が、個々の物が0.05%以下で、不純物の合計が0.15%以下とし、残りをAlとしたもの)を使用した。

このクラッド板1とフィン用の板材2とを、第2図に示す様に、板材2の下端縁を、クラッド板1の上面に突き当てた状態で組み合わせ、本発明のろう付方法、従来の様に水を分散媒として使用するろう付方法、フラックスを使用しない真空ろう付方法により、互いにろう付した所、第1表に示す様な結果を得られた。

尚、第二の実験を行なうに就いては、非腐食性雰囲気として $N_2$ ガス雰囲気を使用したが、ろう付時に於ける露点を $-15^{\circ}\text{C}$ 〜 $-30^{\circ}\text{C}$ の範囲で変化させて、 $N_2$ ガスの濃度がろう付性に及ぼす影響も、併せて試験した。又、ろう付を行なう際には、第2図に示す様に組み合わせられたクラッド材1と板材2とを、 $150^{\circ}\text{C}$ で3分間予熱した後、 $600^{\circ}\text{C}$ で3分間加熱して、ろう付した。

この第1表に於いて、後処理を表わす欄で、「無」とは、ろう付後にフラックスの残渣を洗い流さなかった事を、「有」はろう付後にフラックスの残渣を洗い流した事を、それぞれ表わしている。

又、ろう付性を表わす欄で「非常に良好」は、ろう付後に、クラッド板1の上面と板材2の下端縁との間に形成されるろう材のフィレットが、ろう付部の全長に亘って形良く、途切れる事なく連続している状態を、「良好」は、フィレットの形状は若干悪いが、フィレットはろう付部のほぼ全長に亘って連続しており、ろう付強度には問題がない状態を、「不良」は、フィレットが不連続で、ろう付強度にも問題がある状態を、それぞれ示している。

更に、腐食試験結果の欄には、ろう付後にクラッド板1と板材2との耐食性を測定した試験の結果を、クラッド板1に生じた孔食の内の、最も深いものの深さ(単位mm)で示した。孔食深さが0.1mm以下のものは、耐食性良好と判断される。腐食試験は、JIS H 8681に定められたCASS試験法により720時間(30日間)連続して行なった後、クラッド板1に生じた孔食の深さを測定する事で行なった。CASS試験法は、5%のNaCl懸濁液を、酢酸によってpH3に調整し、更に $\text{Cu}^{2+}$ イオンを塩化第二銅の形で100ppm加えた腐食性液体を、 $50^{\circ}\text{C}$ の雰囲気中で、 $1.0\sim 2.0\text{ml}/80\text{cm}^2/\text{hr}$ の割合で噴霧するもので、試験片は、試験の間中、この腐食性液体の霧中に曝される。

この様な第二の実験の結果を示す第1表から明らかな通り、40〜50%のKFと60〜50%の $\text{AlF}_3$ とを混合して100%としたフラックスを分散媒であるポリブテン中に混合してアルミニウム材の表面に塗布し、このアルミニウム材同士をろう付する場合、露点を $-20^{\circ}\text{C}$ 以下に保つ限り、良好なろう付を行なう事ができ、しかもフラックスの残渣をそのままとしても、ろう付後に於ける耐食性に問題がない事お確認できた。

尚、第1表に比較例3として示したものは、使用したフラックス(KCl;40%、LiCl;19%、NaCl;25%、 $\text{ZnCl}_2$ ;

8%、 $\text{TiF}_3$ ;8%)の残渣がアルミニウム材に対する腐食性を有する為、ろう付後にこの残渣を洗い流さない限り、アルミニウム材の腐食が著しくなるものである。

更に、本発明の効果を確認する為、ポリブテン中に混合するフラックスとして、40〜50%のKFと60〜50%の $\text{AlF}_3$ とを混合して100%とした基本組成物100重量部に対して、 $\text{K}_2\text{SiF}_6$ 、 $\text{K}_2\text{TiF}_6$ 、 $\text{K}_2\text{ZrF}_6$ 、 $\text{K}_2\text{PbF}_6$ の1種又は2種以上を合計で0.5〜5.0重量部加えたものを使用した場合の効果を確認する為に行なった、第三の実験に就いて説明する。この第三の実験では、上述した第二の実験の場合と同様のクラッド板1と板材2とを使用し、露点 $-30^{\circ}\text{C}$ の $N_2$ ガス雰囲気中で、上記第二の実験の場合と同様の手順でろう付を行なった。この第三の実験により、第2表に示す様な結果を得られた。

ろう付後に生じる残渣は、本発明の実施例に就いても、更に比較例に就いても、一切そのままとし、洗い流す事はしなかった。

又、ろう付性を表わす欄で「○」は、ろう付後に、クラッド板1の下端縁と板材2の上面との間に形成されるろう材のフィレットが、ろう付部の全長に亘って、途切れる事なく連続している状態を、「△」は、フィレットがろう付部の一部で不連続となっているが、一応のろう付強度が得られている状態を、「×」は、フィレットが殆ど形成されていない状態を、それぞれ示している。

更に耐食性の欄に於ける「○」は、腐食試験後に於いて、クラッド板1の表面に、腐食に伴う変色(酸化アルミニウムの白色)を全く観察できなかった状態を示している。実験では、比較例を含め、総て腐食性の面からは問題がなかった。

尚、この場合に於ける腐食性の試験は、ろう付後に、クラッド板1と板材2とを恒温槽に入れ、温度 $40^{\circ}\text{C}$ 、相対湿度90%の条件下で、150時間放置する事で行なった。

この様な第三の実験の結果を示す第2表から明らかな通り、本発明のろう付方法によりアルミニウム材同士をろう付する場合、使用するフラックスの量を相当に少なくしても、良好なろう付を行なう事ができ、ろう付後に於ける耐食性にも問題がない事を確認できた。

ろう付時に使用するフラックスの量を少なくできる結果、ろう付後に於けるフラックスの残渣の量も少なくでき、この残渣が熱交換器表の外観を悪くしたり、或はフィンを詰らせたりする事がなくなる。

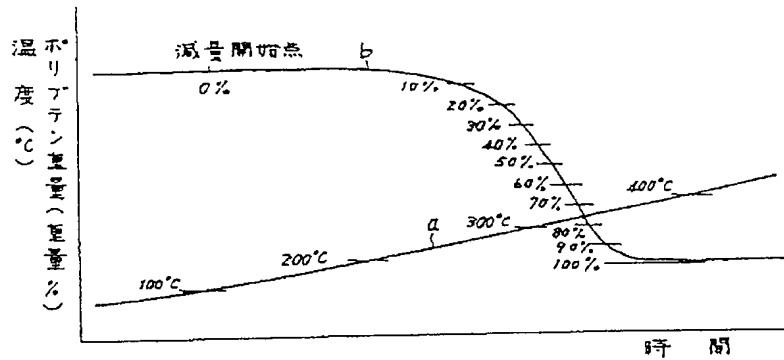
(発明の効果)

本発明のアルミニウム材のろう付方法は、以上に述べた通り構成され実施される為、フラックスを必要な部分にのみ塗布する事が可能となつて、フラックスの使用量低減に伴うろう付製品の製作費低減を図れるだけでなく、余分なフラックスの残渣によるろう付製品の品質、性能の低下を防止できる。更に、フラックスの使用量を少なくしても、アルミニウム材同士のろう付強度を十分

に確保でき、しかも十分な耐食性を確保できる。この結果、優れた耐久性を有し、しかも安価なアルミニウム材ろう付製品を得る事ができる。

【図面の簡単な説明】

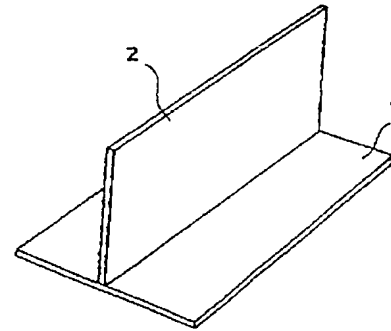
【第1図】



\* 第1図は温度上昇に伴うポリプロピレンの重量減少の状態を示す線図、第2図は互いにろう付される2枚のアルミニウム板材の組み合わせ状態を示す斜視図である。

\* 1:クラッド板、2:板材。

【第2図】



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